

[54] **FILM WINDING MACHINE**

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[51] Int. Cl.B65h 19/26, B65h 19/28

[58] Field of Search.....242/56 A, 64, 55.1, 242/81

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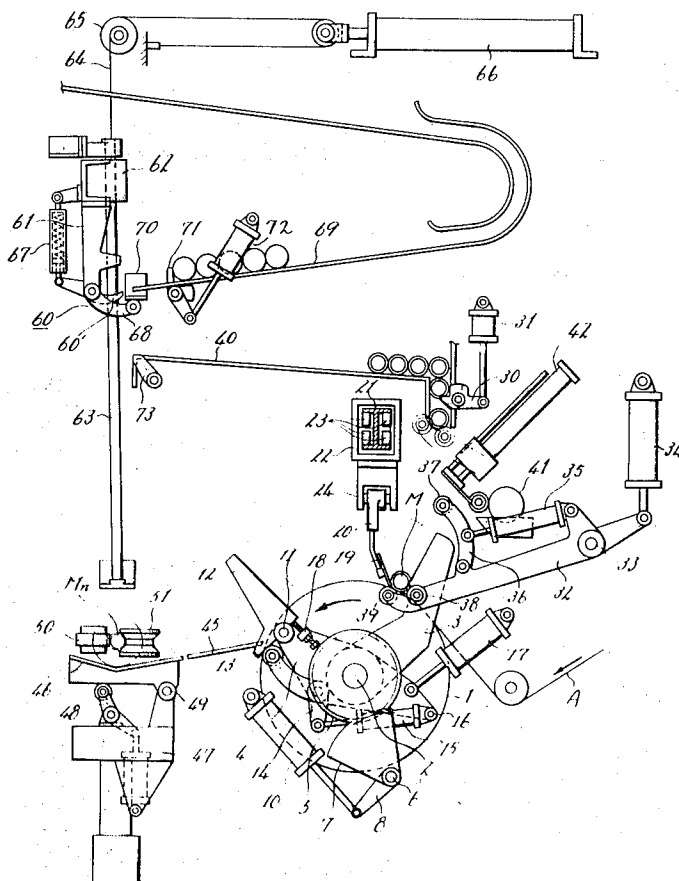
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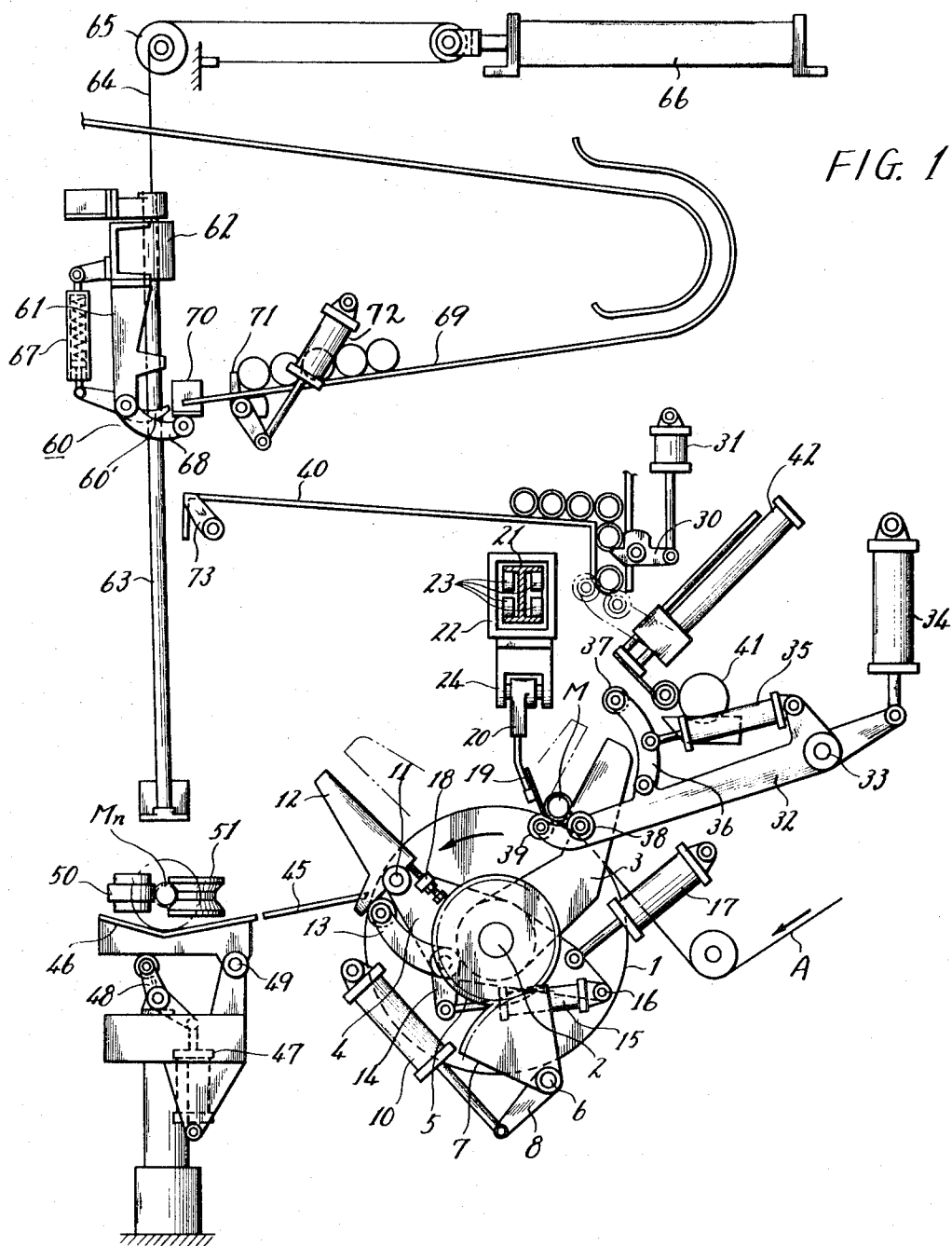
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ABSTRACT

A machine for winding film consecutively and automatically, by a predetermined length, on tubes without stopping the advance of the film which is continuously delivered from a film supply source to this machine, wherein all operations of film winding, film cutting, supplying a winding position with a roll core, discharging a full film roll from the machine, drawing out mandrel from the full film roll, inserting a mandrel into a tube to form a roll core, and shifting the formed roll core to a roll core magazine and a tube from a tube core magazine to a mandrel inserting position are performed in sequence automatically by an electric or pneumatic mechanism set up in accordance with a predetermined program.

3 Claims, 12 Drawing Figures





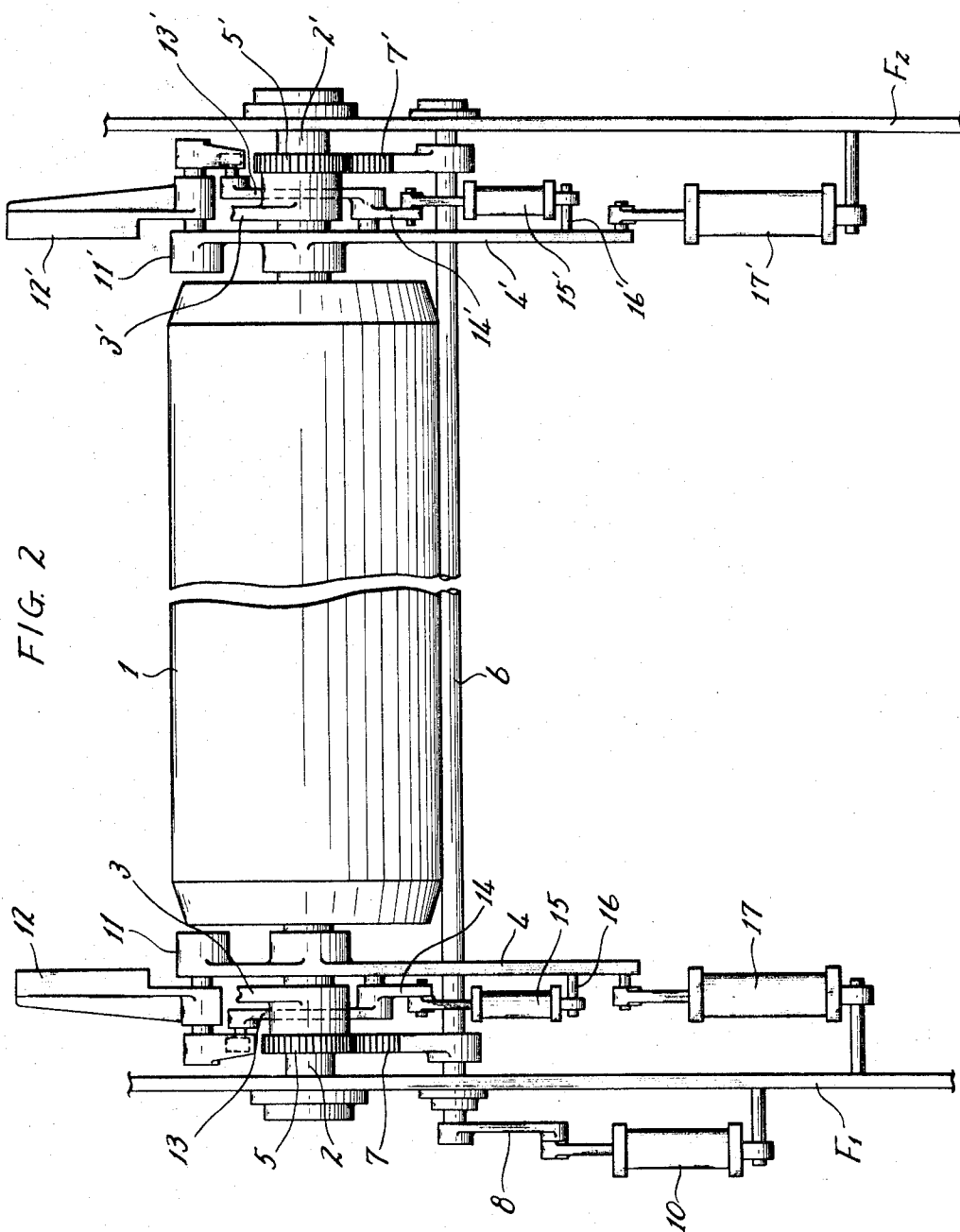


FIG. 3

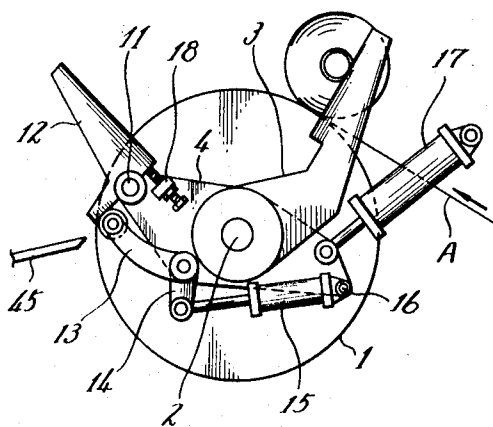


FIG. 4

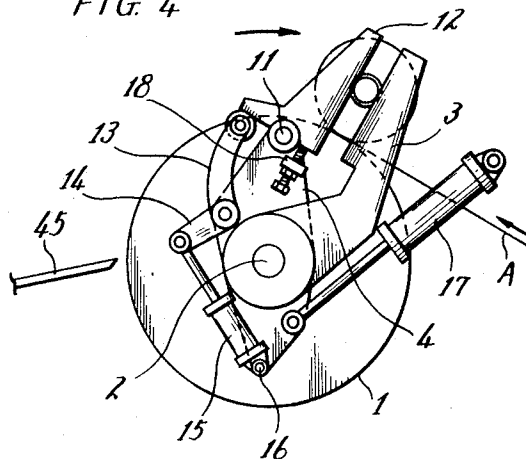


FIG. 5

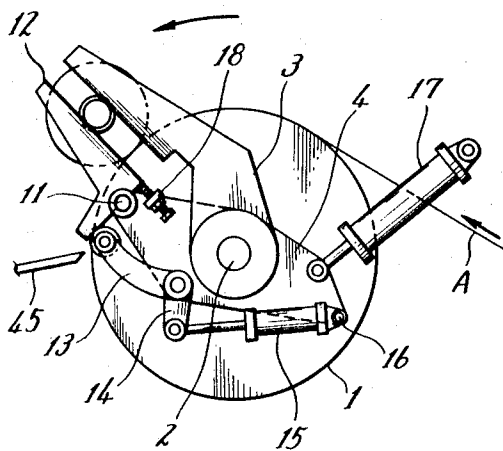


FIG. 6

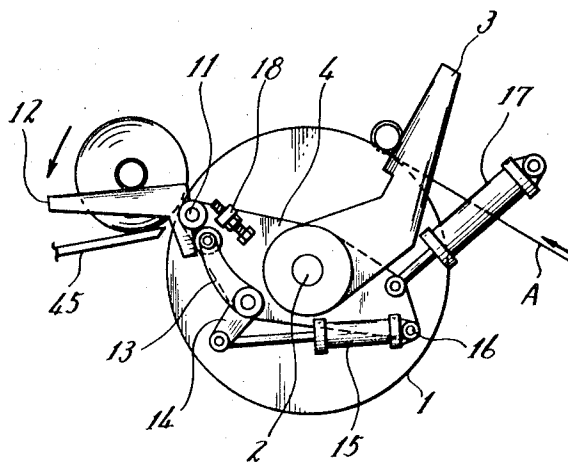


FIG. 7

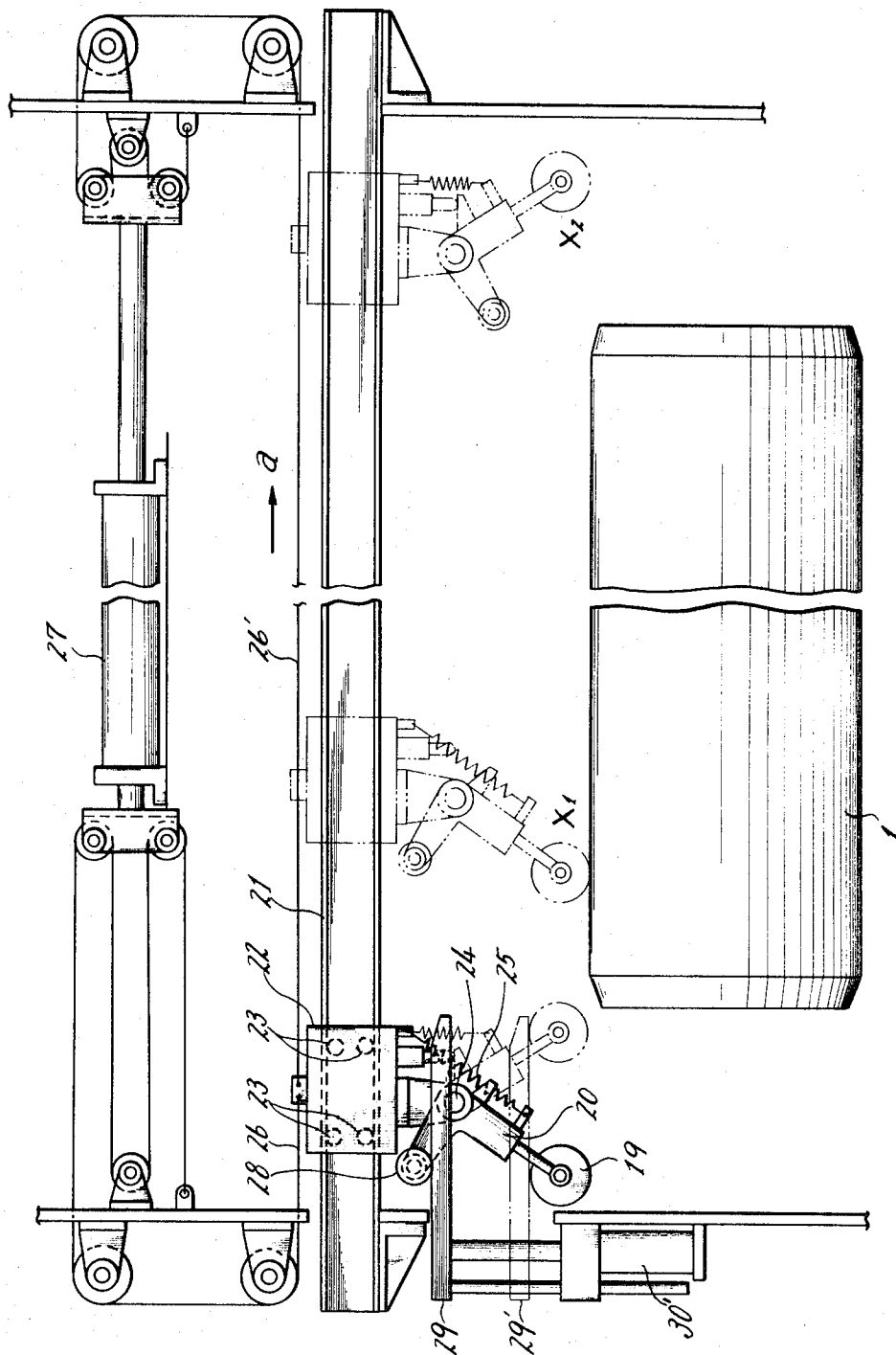


FIG. 8

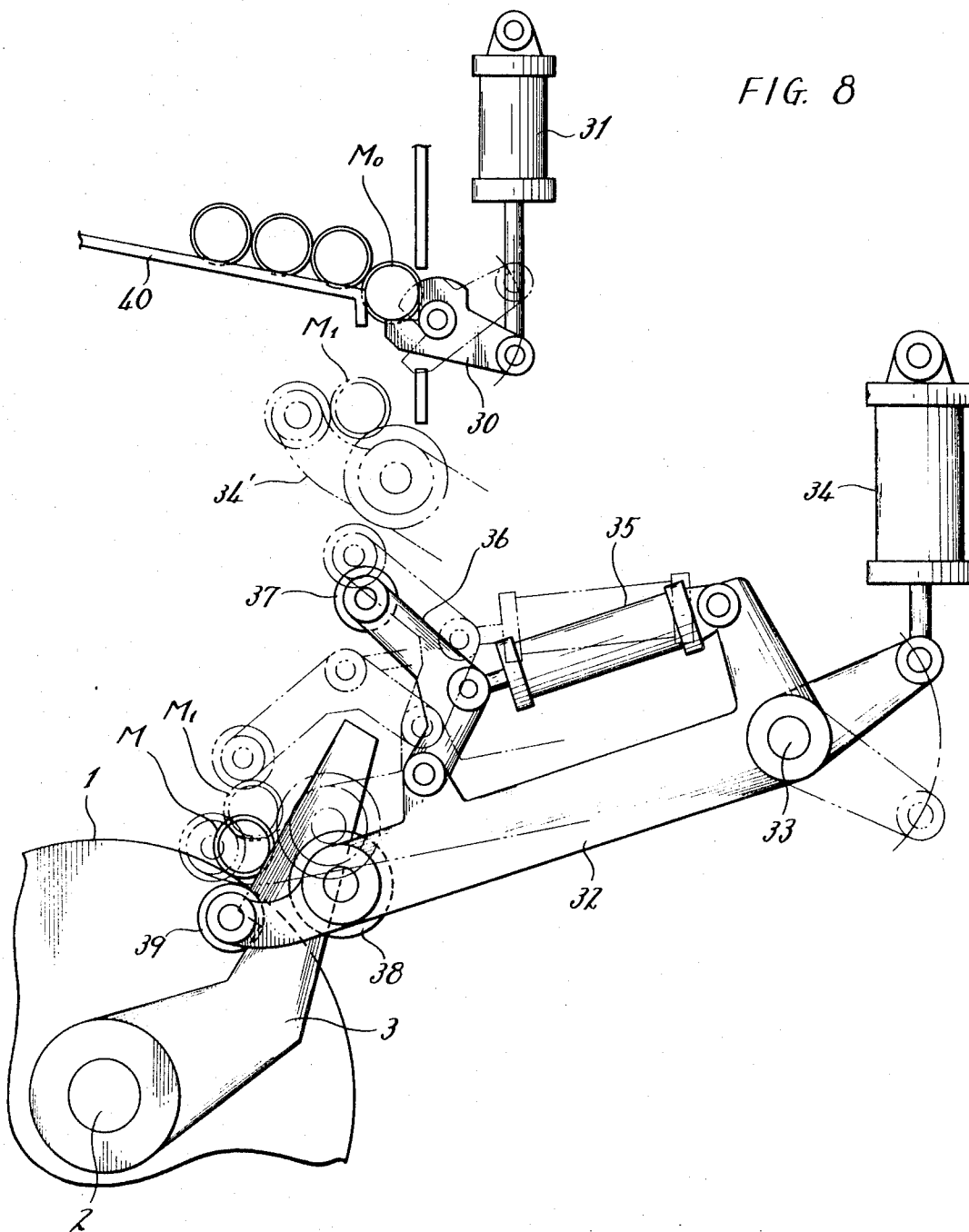
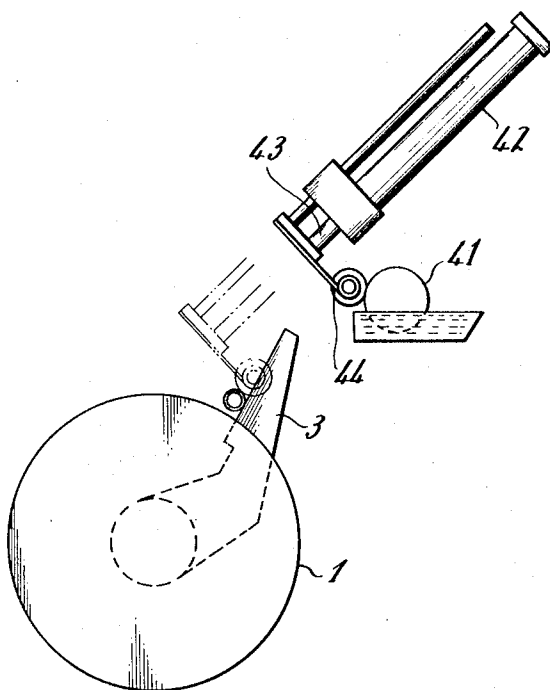


FIG. 9



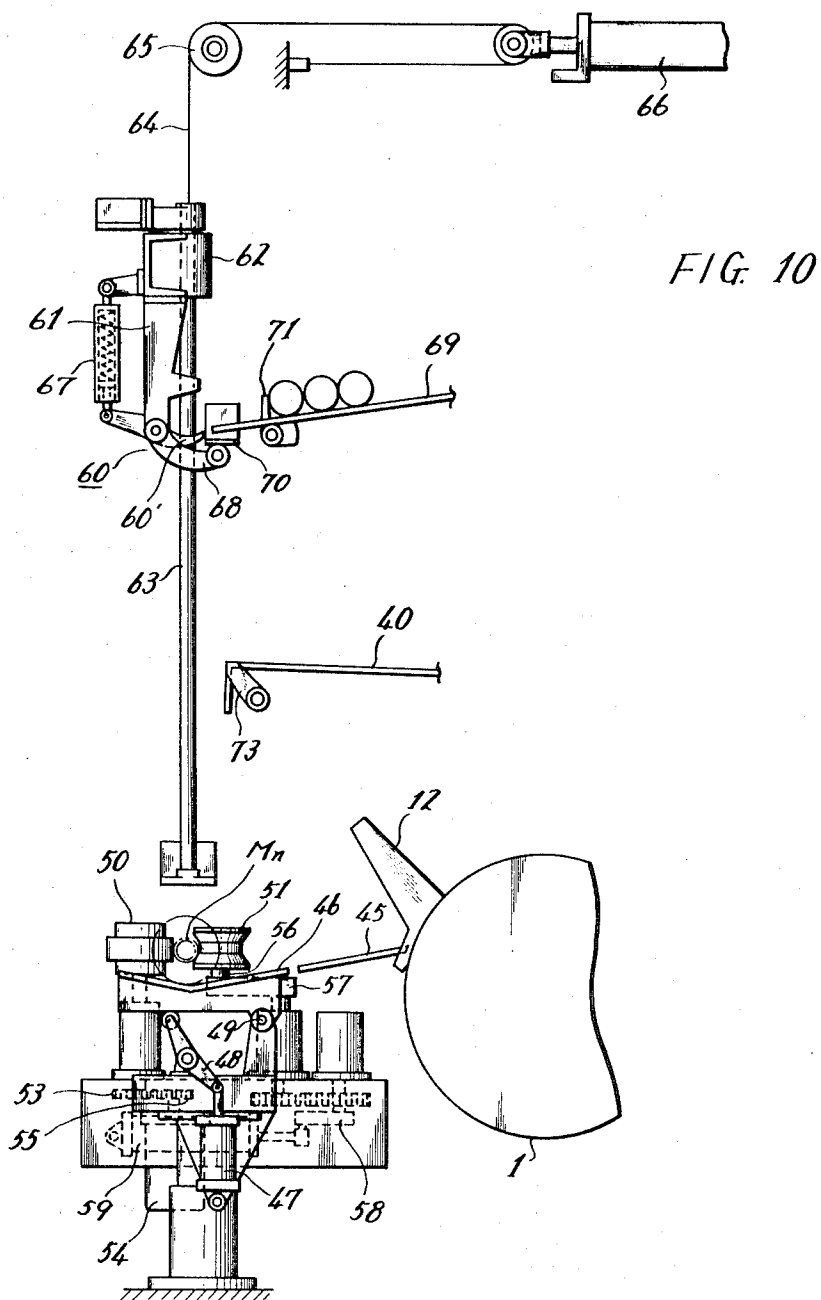


FIG. 11

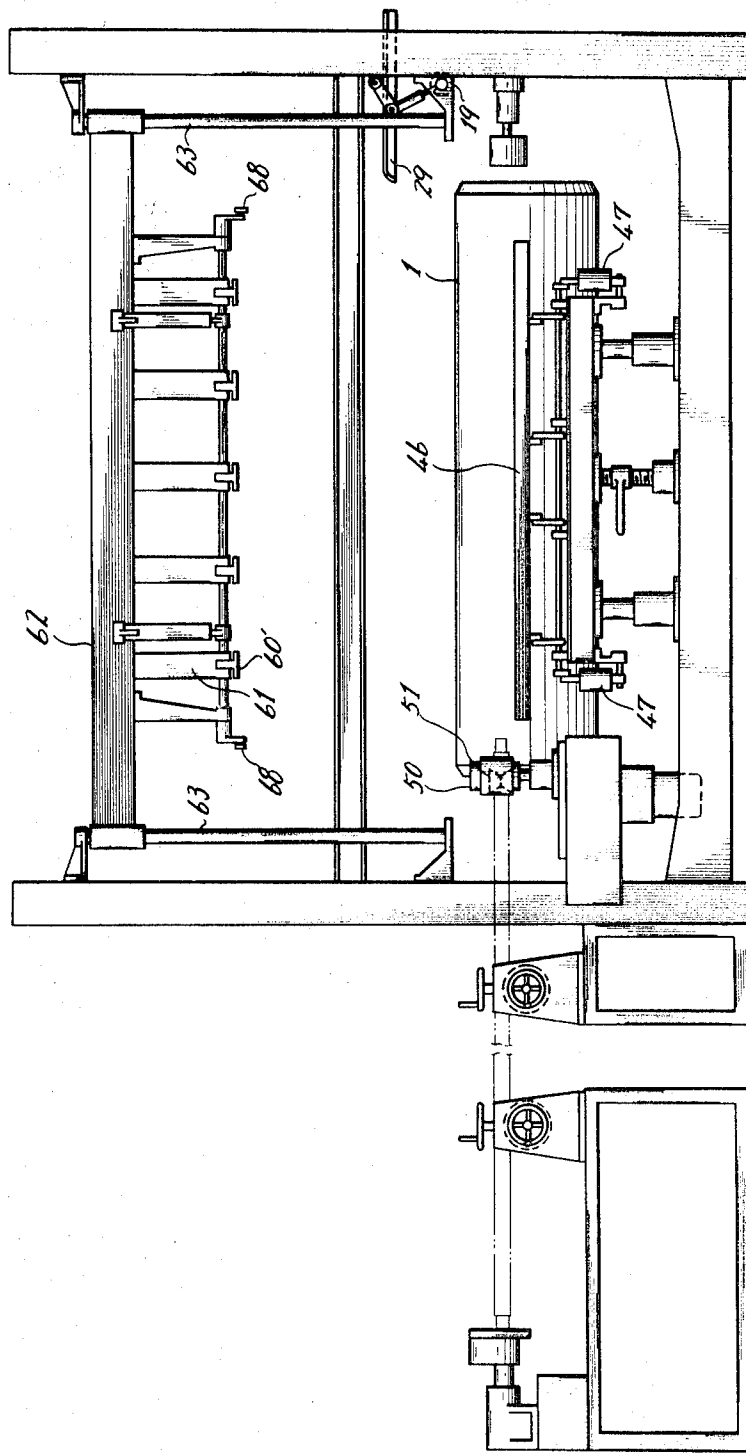
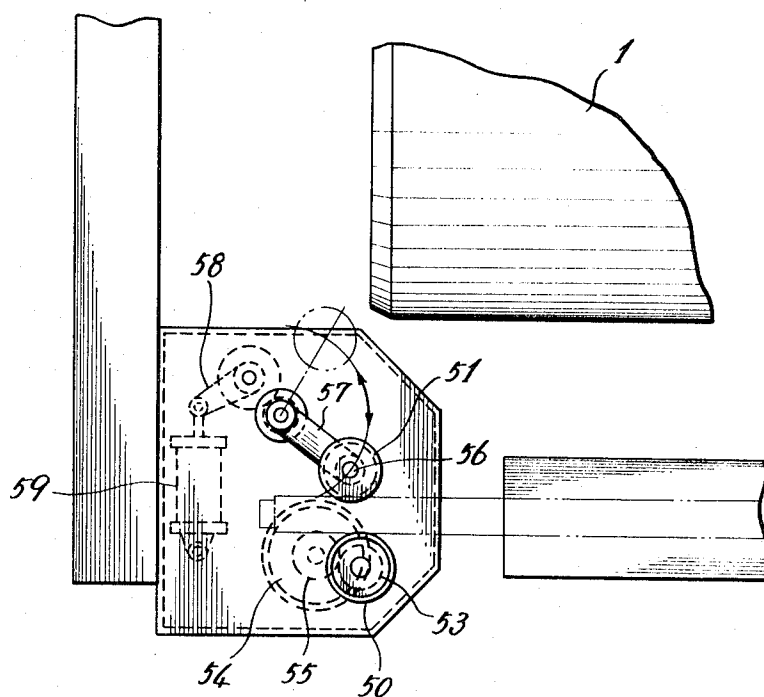


FIG. 12



FILM WINDING MACHINE

This invention relates to a machine for winding consecutively and automatically, by a predetermined length, film of synthetic thermoplastic resin such as polyvinylchloride, polyethylene, polypropylene, polyamides, polyesters and the like on tubes, without stopping the advance of the film which is continuously delivered from a preceding process to this machine.

Nowadays, it is a prevailing process to form a roll of a predetermined length of film by winding around a tube such length of synthetic thermoplastic film (hereinafter referred to simply as "film") which is continuously delivered from a film supply source, e.g., a film manufacturing process or a larger roll of film formed on a tube. However, such a process comprises, in general, steps of putting a paper tube on a mandrel (this assemblage is hereinafter referred to as "roll core"), placing the roll core on a rotating drum which drives the roll core to rotate around its axis by frictional contact therebetween, taking up film being supplied from a film supply source onto the rotating roll core, stopping the rotation of the drum when a predetermined length of film has been rolled up, removing manually the thus formed film roll from the winding position, placing again another roll core on the said position, cutting manually the film and thereafter enwrapping the newly mounted core with the cut end of the film connected to the source. Further, the process involves manual steps of drawing out the mandrel from the removed film roll and putting the mandrel into another paper tube, thereby to prepare a new preliminary roll core.

In the above mentioned conventional process, the steps of the removal of full film rolls, the supply of roll cores and the attaching of the cut end of film to the roll cores are all conducted manually, so that creases are formed on the film at an inner portion as well as the end portion of the rolled film, which considerably deteriorate the product.

Moreover, such a conventional process cannot follow recent film manufacturing processes having high productivity and lowers overall efficiency of film production, wherefor it has resulted in a bottleneck of film industry.

In order to obviate the above mentioned drawbacks, numerous studies were made in the past with respect to automation and continuously processing of film winding, and there have so far been proposed various automatic devices, for instance, an automatic cutting device by means of an electrical heater, an automatic winding device for attaching a cut end portion of film to a roll core by means of air jetted flow impinging thereupon, etc., which have been commonly utilized in a part of film manufacturing processes. However, though those devices employed instead of manual operations have contributed partly towards the automation of the process, yet they cannot attain a synthetic automation of the whole process, so that they are not entirely satisfactory in respect of labor saving as well as of improvement in productivity.

In view of these facts, the inventor engaged himself for a long time in an extensive study of exploiting an improved, synthetically automatic film winding machine and has accomplished the present invention, i.e., a fully automated film winding machine having an excellent operation ability.

Namely, an object of the present invention is to provide an excellent, fully automated film winding machine having a high productivity and reducing labor cost.

Another object of the invention is a provision of an automated film winding machine which can form with ease rolls of a predetermined length of film neither requiring any manual work nor stopping the advance of the film which is continuously delivered from a film supply source to this machine.

A further object of the invention is to provide a synthetically automated film winding machine which enables one to obtain efficiently rolls of film, automatically performing without fail sequential operations organically related with each other for shifting a winding position for a full film roll, supplying a roll core, cutting the film, attaching the cut end of the film to the roll core, removing the full film roll, drawing a mandrel from the film roll and putting the mandrel into another paper tube to form a roll core.

For attaining the above mentioned objects, the feature of the automated film winding machine of the present invention resides in an organically combined mechanism of its following means:

1. A means for winding film which is continuously delivered from a film supply source around a roll core being in frictional contact with a rotating driving drum.

2. A means for shifting a completed full film roll from a first winding position to a second winding position both on the driving drum without stopping the advance of the film, immediately after a predetermined length of film has been wound.

3. A means for automatically supplying the first winding position with a roll core which is being rotated around its longitudinal axis at the same peripheral velocity with that of the driving drum, after the shifting of the full film roll from the first winding position to the second winding position.

4. An automatic cutting and winding means for cutting the film at a position between the newly supplied roll core and the full film roll located at the second winding position and thereafter attaching the cut end of the film of supply side to the roll core, followed by winding up a predetermined length of film around the roll core.

5. A film roll delivery means for shifting the full film roll from the second winding position to a mandrel drawing position where the mandrel is automatically drawn out from the roll core and thereafter discharging the film roll from the machine.

6. A means for holding a paper tube and transporting it from a paper tube magazine to the mandrel drawing position where a mandrel is put into the paper tube to form a roll core and thereafter shifting the assembled roll core to a roll core magazine.

Details of the above mentioned means and mechanism will be further enlightened by the following description, making reference to the accompanying drawings, which are, however, by no means contemplated limiting the scope of the invention, and needless to say, embodiments given hereinafter could be modified to such an extent that they do not depart from the aforementioned objects of the present invention.

FIG. 1 is a schematic side elevational view illustrating arrangements and operation of each device in the film winding machine of the present invention.

FIG. 2 is a fragmentary front elevational view of a driving drum assembly in FIG. 1.

FIGS. 3 to 6 inclusive are illustrative side views for explaining successive operations when and after a predetermined length of film has been wound around a film core.

FIG. 7 is a front elevational view of an embodiment of a film cutting means comprised in the machine of the present invention.

FIG. 8 is an illustrative side view explaining operations for automatically supplying roll cores to the first winding position.

FIG. 9 is a schematic view of a starching device.

FIG. 10 is a side elevational view which shows in details embodiments of a roll core supply means and of a device for drawing and inserting a mandrel.

FIG. 11 is a front elevational view of the embodiment shown in FIG. 10.

FIG. 12 is an illustrative view showing operations of drawing and inserting a mandrel.

Now, in FIGS. 1 and 2, a driving drum 1 horizontally mounted on and between frames F_1 and F_2 has on both its axles 2 and 2' respective first shifting arms 3 and 3' and respective second arms 4 and 4' which are slidably mounted thereon in a forked manner. On the circumference of sleeves from which the first shifting arms 3 and 3' extend, gears 5 and 5' are mounted, which engage respectively with sector gears 7 and 7' fixed on an arbor 6 that is pivotally supported at its both ends on the frames F_1 and F_2 . A lever 8 fixed on one end of the arbor 6 is connected with a first piston cylinder 10 which is rotatably mounted at its bottom end on the frame, so that the operation of the first piston cylinder 10 causes the first shifting arms 3 and 3' to swing around the axis of the driving drum 1 by an angle corresponding to the stroke of the piston.

The second shifting arms 4 and 4' are provided, at their upper ends, respectively with hinges 11 and 11' on which levers 12 and 12' are pivotally mounted respectively and locked by toggles 13 and 13' each provided at its free end with a roll. The toggles 13 and 13' are connected respectively, by arms 14 and 14' extending opposite to the location of the roll, with discharging piston cylinders 15 and 15'. The bottom ends of the discharging piston cylinders 15 and 15' are rotatably mounted on pivots 16 and 16' respectively which are positioned opposite to the hinges 11 and 11' on the second shifting arms 4 and 4'. Further, the second shifting arms 4 and 4' are connected respectively with second piston cylinders 17 and 17' which are rotatably mounted on the frames, so that the operation of the second piston cylinders cause the second shifting arms 4 and 4' to swing around the axis of the driving drum 1 by an angle corresponding to the stroke of piston of the second cylinders, while the discharging piston cylinders 15 and 15' operate so as to release the toggles 13 and 13' from their engagement with the levers 12 and 12' on the second shifting arms and thus the levers 12 and 12' swing around the hinges 11 and 11'. The reference numeral 18 designates stoppers or stops for the levers 12 and 12'.

Next, in FIGS. 1 and 7 which illustrate cutting and winding devices, a cutter 19 supported by a cutter supporting arm 20 is mounted to travel on the surface of the driving drum 1 along it longitudinally. Along a cutter guide beam 21, traverses a carriage or traveller

22 which is provided with eight wheels 23 for reducing a frictional resistance of the traveller while traversing. The cutter supporting arm 20 is attached, with a hinge 24, to the bottom of the traveller 22, hanging therefrom, and pulled by a spring 25 one end of which is fixed on the traveller, in such a manner that the cutter supporting arm 20 may swing counter-clockwise in FIG. 7 and thus the cutter 19 is pressed down against the driving drum 1 when travelling on the driving drum.

The traveller 22 is connected with an appropriate power source. In the embodiment shown in FIG. 7, roller chains 26 and 26' are connected with a piston cylinder for cutter travel 27 through a plurality of chain wheels whereby the motion of the piston cylinder 27 is amplified to fourfold.

The cutter supporting arm 20 is formed into a two-arm lever the vertex of which is attached to the hinge 24, and provided at its end opposite to the cutter with a roll 28 which is borne up by a cutter guide bar 29. The cutter guide bar 29 is raised or lowered by a lift cylinder 30'. Upon operation of the piston cylinder for cutter travel 27, the cutter 19 commences its traverse in a direction a shown by the arrow in FIG. 7 and when the roll 28 has left the cutter guide bar 29, it comes into contact with the surface of the driving drum 1 and further travels thereon along it longitudinally and is pressed down by the spring 25 against the driving drum.

The cutter travelling as mentioned above is shown by chain lines at a position X_1 in FIG. 7. When the cutter 19 gets through its travel on the surface of the driving drum 1, the cutter supporting arm 20 being pulled by the spring 25 is rotated about the hinge 24. Such condition is shown by chain lines at a position X_2 in FIG. 7.

By a reverse action of the piston cylinder for cutter travel 27, the cutter 19 returns to its original position and is kept apart from the surface of the driving drum 1 during its return travel, i.e., in the condition shown at X_2 in FIG. 7. When the cutter 19 returns to its original position, the cutter guide bar 29 is in its lowered position 29' as shown by chain lines in FIG. 7, so that the roll 28 is not interfered with by the cutter guide bar 29. After the cutter 19 has returned to its original position, the cutter guide bar 29 is raised to the position shown by solid lines in FIG. 7.

An automatic supply device for a roll core is illustrated in FIGS. 1 and 8 wherein a roll core magazine stopper 30 is actuated by a piston cylinder for magazine stopper 31 and two supply arms 32 arranged in parallel with each other are mounted at their one ends on an arbor 33 whereby they are enabled to swing concurrently.

With one end of the supply arm 32 a supply piston cylinder 34 is connected. Further, on the supply arm 32, a piston cylinder 35 is pivotally mounted which is connected with a lever 36. One end of the lever 36 is pivotally attached to the supply arm 32 and the free end thereof is provided with an idler roll 37. On and between the respective free ends of the supply arms 32, two driving rolls 38 and 39 are mounted in parallel with each other which are being rotated, by an appropriate driving means, at a peripheral velocity corresponding with the film delivery speed.

Feed of the roll core M onto the driving drum 1 is conducted by the supply arm 32. Upon operation of the supply piston cylinder 34, the supply arm 32 swings so

that its free end may be raised up to a position 34' beneath the roll core magazine stopper 30 and subsequently, the piston cylinder for magazine stopper 31 works so as to rotate the roll core magazine stopper 30, whereby the outermost roll core M_o retained in the magazine drops and is received by the supply arm 32 standing by at the position 34'.

The supply arm 32 which has been loaded with the roll core M_i is lowered by the working of the supply piston cylinder 34. On its way downward, the piston cylinder 35 works to swing the lever 36, so that roll core M_i loaded on the end of the supply arm 32 is held by the idler roll 37 and driving rolls 38 and 39, when the roll core M_i is driven by the driving rolls 38 and 39, to rotate at a peripheral velocity synchronous with the film delivery speed.

Above the aforementioned supply device for roll core which comprises the supply arm 32 as its main part, a starching device is positioned. This device serves to apply starch to a marginal part of the rotating roll core M_i , in the form of a band, when the roll core M_i held by the above mentioned supply arm 32 and driven by driving rolls 38 and 39 comes to a position a little above the driving drum 1.

The starching device is shown in FIG. 9 wherein a starching roll 41 the bottom of which is immersed in a starch bath is revolved slowly by an appropriate driving source and a pneumatic piston cylinder 42 is provided with a plunger 43 which has at its end a furnisher roll 44. The furnisher roll 44 is brought into contact with the starching roll 41 whereby starch is transferred from the starching roll 41 to the furnisher roll 44. Just before the rotating roll core M_i is shifted from the supply arm 32 to the driving drum 1, the pneumatic piston cylinder 42 works to press the furnisher roll 44 to the awaiting roll core M_i and starch adhered on the furnisher roll 44 is applied to the roll core M_i .

On the other hand, as shown in FIGS. 10 to 12, the machine of the present invention includes a device for drawing and inserting a mandrel and a device for transporting a paper tube into which a mandrel is inserted, i.e., a roll core to a roll core magazine. These devices interrelate with the aforementioned device and characterizes the present invention. Principal parts of these devices, i.e., a means for drawing and inserting a mandrel and a means for transporting and feeding roll cores are explained hereinafter in accordance with FIGS. 1 and 10.

In FIG. 1, a receiving member 46 for full roll cores is positioned at a delivery side of the second shifting arm 4 and a gangboard 45 is laid between the receiving member 46 and the second shifting arm 4. The receiving member 46 can swing up or down about a shaft 49 by engaging itself with or disengaging from a discharging toggle 48 which is connected with a piston cylinder 47 whereby the full roll core is discharged from the receiving member 46. On one side of the receiving member 46, a device for drawing and inserting a mandrel M_n of roll core is installed, which is adapted for drawing a mandrel from a full roll core placed on the receiving member 46 and for inserting it into a paper tube which is placed on the receiving member after the film roll has been discharged.

An embodiment of the device for drawing and inserting the mandrel M_n is shown in FIGS. 10 to 12. This

device comprises basically a pair of rolls, i.e., a draw roll 50 and a fluted press roll 51. The draw roll 50 is provided with a gear wheel 53 wedged up on the bottom end of its axle 52. The gear wheel 53 is engaged with another gear wheel 55 which is wedged up on a shaft of a motor 54 and thus transmit revolution from the motor 54 to the draw roll 50. On the other hand, the press roll 51 is rotatably mounted on a shaft 56 which is pivotally mounted on a lever 57. The lever 57 is connected through a link 58 with a fluid pressure acting piston cylinder 59.

Thus, upon starting up of the motor 54, the draw roll 50 is rotated through the gear wheels 53 and 55 and draws laterally a mandrel M_n which is held by and between the draw roll 50 and the press roll 51. During the drawing action, the press roll 51 is driven by the movement of the mandrel M_n contacted therewith and the mandrel M_n is led through guide rolls. When the mandrel M_n has been drawn out from the full roll core, the motor stops and the aforementioned receiving member 46 commences its swing down motion to discharge the film roll.

A tube supply device is located above the aforementioned device for drawing and inserting a mandrel M_n , which is shown in detail in FIGS. 1, 10 and 11. Referring to Figures, tube catcher 60 is connected by connecting arms 61 with a beam 62 which is slidably mounted on and between two guide bars 63 fixed vertically on the machine frames. At the both ends of the beam, slide bearings (not shown) are encased and mounted slidably on guide bars 63. The tube catcher 60, connecting arms 61, beam 62 and the slide bearings are all together hung down by roller chains 64 and connected through chain wheels 65 with a fluid pressure acting piston cylinder 66. The aforementioned tube catcher 60 is provided with jaws 60' and arms 68. When the arms 68 comes into contact with fixed dogs 70 which are protrusively located beneath the tip of a tube magazine rail 69, the jaws 60' swing downward to open and are enabled to receive a paper tube rolling therein.

In FIGS. 1 and 10, a stopper 71 is operated by an action of a fluid pressure acting piston cylinder 72 so as to release and deliver paper tubes one by one to the tube catcher 60. The jaws 60' are normally in a raised and closed state by resilience of springs 67. When the tube catcher 60 loaded with a paper tube descends and the arms 68 become apart from the fixed dogs 70, the tips of jaws 60' are raised by the force of the springs 67, so that the paper tube is held by the tube catcher 60.

When the tube catcher 60 has reached to the mandrel drawing and inserting position just above the receiving member 46, the draw roll 50 is reversely rotated in order to insert the mandrel M_n into the paper tube. Under the tube magazine rail 69, a roll core magazine 40 is arranged, which receives a roll core, i.e., a paper tube combined with a mandrel. The roll core magazine 40 has at its entrance a cam 73 which is worked by a coil-spring (not shown) so as to be rotated counter-clockwise and recoiled to its original state upon removal of force acted thereon.

Accordingly, when the tube catcher 60 loaded with a paper tube descends, the arm 68 pushes down the cam 73 to rotate counter-clockwise permitting the tube catcher 60 to pass freely. On the other hand, when the

tube catcher loaded with a roll core combined with a mandrel ascends, the above mentioned cam 73 presses the arm 68 of the tube catcher 60 downward, so that the jaws 60' open and the roll core is discharged and shifted to the roll core magazine 40.

Now, a series of operations of the film winding machine of the present invention will be illustrated hereafter based on the above mentioned mechanism.

In FIGS. 1 through 6, a roll core M is placed on the driving drum 1 and the mandrel M_n of the roll core M is supported at its both ends by rolls of the first shifting arms 3 and 3'. The roll core is surface driven by the driving roll 1 and winds up thereon film being delivered from the preceding process. As soon as a detector detects the film roll size has reached a predetermined diameter, the second shifting arms 4 and 4' swing to approach to the first winding position adjacent to the first shifting arms 3 and 3', in order to bring the full film roll (FIG. 4 is referred to). Next, the first shifting arms 3 and 3', swing slowly, holding the both ends of the mandrel of the full film roll between the first shifting arms 3 and 3' and the second shifting arms 4 and 4', functioning as two pairs of grippers, shift the full film roll to the second winding position (FIG. 5 is referred to). Subsequent to the above each of, the first shifting arms 3 and 3' returns to its original position by the working of a change-over switch of air supply for the first piston cylinder 10, when the second shifting arms 4 and 4' stop at its regular position.

Thereafter, the supply arm 32 swings upward upon operation of the supply piston cylinder 34 and the roll core magazine stopper 30 rotates to permit a roll core in the roll core magazine 40 to drop onto the supply arm 32 which is awaiting at a receiving position 34' shown in FIG. 8. After being loaded with the roll core M_1 , the supply arm 32 swings back downward. On its way downward, the lever 36 attached to the supply arm 32 swings, whereby the roll core is held at three points and at the same time, driving rolls 38 and 39 on the supply arm commence to rotate.

When the peripheral velocity of the rotating roll core held by the supply arm 32 becomes the same as the running velocity of the film, the roll core comes down to and stands by at a position where the bottom of the roll core is kept approximately 5mm apart from the surface of the driving drum 1.

Then, the starching device starts its working and the furnisher roll 44 applies starch, in a form of a band, to a marginal part of the rotating roll core (FIG. 9 is referred to).

On the other hand, along the cutter guide beam 21, the cutter 19 traverses, on the surface of the driving drum 1, across the running film whereby film is cut. Before the commencement of the above mentioned cutting operation, i.e., just before the cutter 19 reaches the selvage of film, the supply arm 32 awaiting as mentioned above descends rapidly to put the roll core on the driving drum 1. Since the roll core M has its marginal part applied with starch, a bias cut end of the film is wound on the roll core.

After cutting the film, the cutter 19 at the terminal of its travelling path is pulled up by the spring 25 and returns to its original position as it is kept apart from the surface of the driving drum 1.

Then, the full film roll in the second winding position is discharged and shifted onto the receiving member 46. Namely, in the second winding position, the mandrel M_n is supported by the second shifting arms 4 and 4'. The second shifting arms 4 and 4' are connected by hinges 11 and 11' respectively with levers 12 and 12' which are kept upright by toggles 13 and 13'. Upon disengagement of the toggles 13 and 13' from the levers 12 and 12', these levers fall down and the full roll core rolls down over the gangboard 45 to the receiving member 46 (FIG. 6 is referred to).

From the full roll core placed on the receiving member 46, at first the mandrel M_n is drawn out by the device for drawing and inserting a mandrel which is worked by a pneumatic cylinder. The above mentioned drawing operation is conducted by holding the mandrel between two rolls 50 and 51 and one of these rolls is revolved by means of motor drive, to draw out the mandrel M_n .

The film roll from which the mandrel M_n has been drawn out is discharged from the machine upon swinging down of the receiving member 46.

While the mandrel M_n is drawn out of the full roll core and the film roll is discharged from the machine as above, the tube catcher 60 loaded with a paper tube comes down from above. When the tube catcher 60 has reached a mandrel inserting position that is same with a mandrel drawing position and just above the receiving member 46, the draw roll 50 is rotated reversely to insert a mandrel M_n into the paper tube held by the tube catcher 60. After completion of the insert of the mandrel M_n into the paper tube, the tube catcher 60 ascends. When it passes by the entrance of the roll core magazine 40 on its way upward, its arm 68 engages with the cam 73, whereupon the roll core is released from holding and delivered onto the roll core magazine 40.

The above mentioned is an embodiment of sequential operations for film winding, film cutting, supply and discharge of roll core, preparation of roll core, etc., and all of those operations are performed in sequence automatically by an electric or pneumatic mechanism set up in accordance with a predetermined program.

The film winding machine of the present invention has its mechanism and function as mentioned above, and therefore is suitable for automatic operation in well accordance with nature of film as well as with delivery speed of film. Further, since the winding operation of the present machine can be conducted automatically and consecutively without stopping it even when full film roll doffing and tube donning, considerable labor saving and extremely high efficiency are achieved, so that the present invention contributes to rationalization of a film winding process.

Furthermore, it is a very important feature of the present invention that sequential operations for mandrel drawing and inserting, film cutting, roll core supplying, etc. are performed smoothly according to a sequence control by mechanical and electrical means and that a uniform roll of film of constant length having none of split, crease and strain is obtainable.

What is claimed is:

1. An automatic machine for automatically winding film on individual cores to form rolls of film comprising, a rotationally driven drum, core delivery means to deliver cores individually sequentially to said rotatably

driven drum at the surface thereof at a first winding position for rotation by said drum by frictional contact and including means to rotatably drive the cores individually before placement on said drum and at a peripheral speed approximating a linear speed of a film advanced longitudinally for winding on said cores individually to form rolls of film, means cooperating with said core delivery means to apply an adhesive to the cores individually prior to delivery of the cores to said driven drum, means to deliver a film to said driven drum longitudinally for application against said adhesive on the individual cores for winding respective lengths of film on the individual cores during rotation thereof at said first position to form individual rolls of film, means to deliver the individual rolls of film to a second position on said driven drums while continuing to rotate the individual rolls while winding film thereon, means to selectively sever the advancing film to terminate the winding of film on the individual rolls and to apply the film severed to the adhesive of a next successive core for winding film thereon, means to eject the wound rolls of film from said second position

as an output of said machine, said means to deliver the rolls of film from the first position to the second position comprising two pairs of grippers, and means for operating the grippers of each pair jointly and separately selectively for positioning one of the grippers of each pair in position to hold the individual cores and rolls of film in said first position and for moving grippers to each pair to move the rolls of film individually from said first position to said second position.

2. An automatic machine for automatically winding film on individual cores according to claim 1, including means to automatically insert mandrels into the individual cores before delivery to said driven drum and including means to automatically remove the mandrels from the completed rolls of film individually.

3. An automatic machine for automatically winding film on individual cores according to claim 2, in which said means to insert and remove the mandrels in and from the cores comprises a pair of rolls rotatable in one direction for removing the mandrels and in an opposite direction for inserting the cores.

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